

APPENDIX A

FEDERAL COORDINATION AND PLANNING

BASIS FOR FEDERAL COORDINATION PROCESS

In 1963, Congress and the Executive Office of the President expressed concern about the adequacy of coordination of Federal meteorological activities. In response, Congress directed in Section 304 of Public Law 87-843--the Appropriations Act for State, Justice, Commerce, and Related Agencies--that the Bureau of the Budget prepare an annual horizontal budget for all meteorological programs in the Federal agencies.

The Bureau of the Budget (now the Office of Management and Budget) issued a report entitled "Survey of Federal Meteorological Activities" (1963). The report described each agency's program in some detail, particularly its operational services, and detailed the relationship between the programs of the various agencies. The report revealed close cooperation but little evidence of systematic coordination. Based on this study, the Bureau of the Budget issued a set of ground rules to be followed in the coordination process. It established a permanent general philosophy for assignment and assessment of agency roles in the field of meteorology and set certain goals to be achieved by the coordination process. The Bureau of the Budget tasked the Department of Commerce (DOC) to establish the coordinating mechanism in concert with the other Federal agencies. It also reaffirmed the concept of having a central agency--the DOC--responsible for providing common meteorological facilities and services and clarified the responsibilities of other agencies for providing meteorological services specific to their own needs.

The implementation of these directives by DOC led to the creation of the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) which operates with policy guidance from the Federal Committee for Meteorological Services and Supporting Research. The principal work in the coordination of meteorological activities and in the preparation and maintenance of Federal plans is accomplished by the OFCM staff with the advice and assistance of the Interdepartmental Committee for Meteorological Services and Supporting Research, and over 30 program councils, committees, working groups, and joint action groups.

MISSION AND STAFFING OF THE OFFICE OF THE FEDERAL COORDINATOR FOR METEOROLOGY (OFCM)

The mission of the OFCM is to ensure the effective use of Federal meteorological resources by leading the systematic coordination of operational weather requirements and services, and supporting research, among the Federal agencies. To discharge its mission, OFCM has meshed its objectives with the objectives of the agencies that provide the services and perform the research.

These objectives include:

- Documenting agency programs and activities in a series of national plans and reports that enable agencies to revise/adjust their individual ongoing programs and provide a means for communicating new ideas and approaches to fulfill requirements.

- Providing structure and programs to promote continuity in the development and coordination of interagency plans and procedures for meteorological services and supporting research activities.
- Preparing analyses, summaries, or evaluations of agency meteorological programs and plans that provide a factual basis for the Executive and Legislative branches to make appropriate decisions related to the allocation of funds.
- Reviewing Federal weather programs and Federal requirements for meteorological services and supporting research. This review may suggest additions or revisions to current or proposed programs, or identify opportunities for improved efficiency, reliability, or cost avoidance through coordinated actions or integrated programs.

DOC currently has ten positions assigned to OFCM. DOC also provides administrative support to OFCM and approximately one-half of OFCM's annual operating budget. The Department of Defense (DOD) currently provides two senior staff officers--one Air Force and one Navy--and contributes approximately one-fourth of the annual operating budget. The Department of Transportation (DOT) Federal Aviation Administration (FAA) provides one professional staff member and also provides approximately one-fourth of the annual operating budget. These three agency representatives are designated Assistant Federal Coordinators for liaison to their respective agencies. In all, 13 meteorologists, oceanographers, physical scientists, and administrative and computer-support personnel are assigned to the OFCM staff.

FEDERAL COMMITTEE FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

The Federal Committee for Meteorological Services and Supporting Research (FCMSSR), established in 1964, provides policy-level agency representation and guidance to the Federal Coordinator to address agency priorities, requirements, and issues related to services, operations, and supporting research, and also resolves agency differences that arise during the coordination of meteorological activities and the preparation of Federal plans. The Under Secretary of Com-

merce for Oceans and Atmosphere, who is also the Administrator of the National Oceanic and Atmospheric Administration (NOAA), serves as the FCMSSR Chairperson.

The 15 Federal agencies that engage in meteorological activities, or have a need for meteorological services, are represented on FCMSSR. The FCMSSR membership includes: DOC, DOD, DOT, the Departments of Agriculture (USDA), Energy (DOE), Homeland Security (DHS), Interior

(DOI), and State (DOS), the Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), National Transportation Safety Board (NTSB), Nuclear Regulatory Commission (NRC), the Office of Science and Technology Policy (OSTP), and the Office of Management and Budget (OMB).

HIGHLIGHTS FOR FISCAL YEAR 2005 AND PLANS FOR FISCAL YEAR 2006

NATURAL DISASTER REDUC- TION

INTERDEPARTMENTAL HURRI- CANE CONFERENCE

The OFCM annually hosts the Interdepartmental Hurricane Conference (IHC) to provide a forum for the responsible Federal agencies, together with representatives of the user communities such as emergency management, to review the Nation's hurricane forecast and warning program and to make recommendations on how to improve the program. The OFCM hosted the 59th IHC in Jacksonville, Florida, March 7-11, 2005. The theme of the 2005 conference was *The Nation's Tropical Cyclone Program-Priorities for the Next Decade*. The conference attendance was 213; for the sixth consecutive year, attendance has exceeded 200. The 59th IHC was cohosted by the Office of the Oceanographer of the Navy. The keynote address for the conference was given by Dr. James R. Mahoney, Assistant Secretary of Commerce for Oceans and Atmosphere and NOAA Deputy Administrator. At its November 16, 2004, meeting, the Interdepartmental Committee for Meteorological Services and Supporting Research

(ICMSSR) strongly supported the 58th IHC action item to develop a comprehensive strategy for tropical cyclone research and development to guide interagency efforts over the next decade. In response to that action, the Joint Action Group for Tropical Cyclone Research (JAG/TCR) was formed, and the group conducted a strategic planning session during the 59th IHC to begin developing the framework for a *Strategic Research Plan for Tropical Cyclones*. This effort will build upon the goals and objectives of the OFCM-sponsored *National Plan for Tropical Cyclone Research and Reconnaissance (1997-2002)* and the *U.S. Weather Research Program Hurricane Landfall Implementation Plan*, and articulate the interagency tropical cyclone research priorities for the next decade. The goal is to complete the plan prior to the 60th IHC in March 2006. The conference also highlighted the success of the Stepped Frequency Microwave Radiometer (SFMR), which provides critically needed surface-wind and rainfall-rate information in the tropical cyclone environment, supporting National Hurricane Center and emergency management requirements. The SFMR, which is currently flown on NOAA's WP-3D

aircraft, is being transitioned from research to operations. In fact, as a result of the 2004 hurricane season which ravaged the state of Florida, the Department of Defense received a \$10.5 million Congressional supplement to install the SFMR on the Air Force Reserve Command's WC-130J hurricane hunter aircraft. Initial operational capability is scheduled for August 2006. Financial support for the SFMR development was provided by the OFCM through the Improved Weather Reconnaissance Program. Other actions from the 59th IHC include the development of a comprehensive long-term interagency strategy for airborne reconnaissance observations as a subset of the Global Earth Observation System of Systems (GEOSS); facilitating a meeting of Web site owners from NHC, FEMA, USACE, etc., to discuss improved linkages, formats, and other related issues needed to improve customer use and understanding; and developing a path ahead to implement recommendations from the OFCM-sponsored study *Warning Messages-Exploring Customer Understanding*, which was completed in June 2005, to improve the understanding and use of tropical cyclone forecasts and warnings. In

May 2005, the 43rd edition of the *National Hurricane Operations Plan (NHOP)*, which provides the basis for hurricane reconnaissance for the 2005 season and details Federal agency responsibilities, operations, and procedures; products; aircraft, satellite, radar, and buoy data collection; and marine weather broadcasts, was published based on the inputs and discussions from the 59th IHC. The comprehensive NHOP was critical to ensuring successful weather and reconnaissance operations for the 2005 hurricane season.

POST-STORM DATA ACQUISITION

The OFCM will continue to coordinate, as required, timely post-storm data acquisition surveys in response to Presidentially declared natural disasters and other agency requirements to evaluate, for example, the impact on the coastal ecosystems. These natural disaster reduction efforts contribute to the determination of the intensity and magnitude of storms, and, in many cases, help to determine the extent of damage for use in Presidential disaster declarations. The additional data collected after hurricane landfall is also used in validating modeling efforts with both emergency management models (e.g., FEMA's HAZUS) and hurricane storm-surge models (e.g., NOAA's SLOSH). These models are used in real-time to assist decision makers in evacuation decisions and procedures. Post-storm data are also used to update FEMA Flood Insurance Rate Maps. In FY 2005, post-storm surveys were conducted for Hurricane Dennis; tornado occurrences during March in Houston County in Southeast Alabama, and in Seminole, Miller, and Mitchell Counties in Southwest Georgia; and Hurricane Katrina. A senior OFCM staff person is spearheading efforts in the development of a Memorandum of Understanding (MOU) between the Department of Commerce (DOC)/OFCM and the Department of

Defense/Office of the Secretary of Defense, to provide USAF Auxiliary-Civil Air Patrol aerial support and reconnaissance for post-storm and natural disaster data assessment. The MOU has been approved by the NOAA General Counsel's Office and is currently being reviewed at the DOC level. It will then be forwarded to the Air Force for their concurrence.

URBAN METEOROLOGY

The OFCM, in partnership with the Department of Homeland Security (DHS) Science and Technology Directorate, conducted a User Forum on Urban Meteorology, September 21-23, 2004, at the Doubletree Hotel and Executive Meeting Center in Rockville, Maryland. The theme of the forum was *Information to Improve Community Responses to Urban Atmospheric Hazards, Weather Events, and Climate*. It focused on the following elements of urban meteorology: severe weather, homeland security, air quality, water quality, and climate. This interagency forum was the direct result of an action item from the October 18, 2002, meeting of the FCMSSR. The forum's proceedings were completed in March 2005. In accordance with direction received at the November 16, 2004, meeting of ICMSSR, the OFCM developed clear guidelines and direction for establishing an interagency working group to address the actions that resulted from the forum. This was submitted to the ICMSSR members on June 29, 2005. The OFCM obtained Committee approval for formation of the Working Group for Urban Meteorology (WG/UM) and has implemented the working group. The goal of WG/UM is "...to define a multi-agency coordinated R&D program to support implementation of tools and systems for cost-effective mitigation of severe weather events and other weather-related hazards in the urban environment. The hazard categories include severe weather

events, homeland security (emergency response to airborne hazards), air and water quality hazards, and climate-related conditions."

CLIMATE

During FY 2005, the OFCM made contributions to climate activities in the following two primary areas: in connection with the Urban Meteorology User Forum which was held September 21-23, 2004, and the U.S. Climate Change Science Program (CCSP). The Urban Meteorology User Forum focused on the following elements of urban meteorology: severe weather, homeland security, air quality, water quality, and climate. Results of the forum were briefed at the November 16, 2004, meeting of the ICMSSR and, as a result, OFCM was tasked to develop clear guidelines and direction for establishing an interagency working group to address actions from the forum, and to coordinate and develop an interagency document covering an urban meteorology program, including climate. Dr. James R. Mahoney, Director of the U.S. Climate Change Science Program, briefed the FCMSSR at its December 1, 2004, meeting. Dr. Mahoney noted that many challenges lie ahead for the CCSP program, particularly those related to the budget process and delivering the best possible science to inform decision makers. It was decided that FCMSSR members will continue to stay abreast of the CCSP and will coordinate priorities for atmospheric requirements through OFCM for inclusion in the CCSP. An OFCM Senior Staff Meteorologist serves as a liaison to the CCSP and the Subcommittee on Global Change Research and is continuing to participate in CCSP activities. She attended the March 2, 2005, CCSP meeting and is supporting plans for the November 14-16, 2005, workshop on *Climate Science in Support of Decision Making* to be held in Arlington, Virginia. She

also attended the March 9, 2005, CCSP Communications Interagency Working Group (CIWG) meeting which discussed the provision of general information about CCSP to the public. The OFCM staff person attends the monthly meetings of CIWG and also helped design the template for its quarterly fact sheets. The OFCM has also developed and coordinated a climate products and services survey for use by its interagency Committee for Climate Analysis, Monitoring, and Services (CCAMS). A meeting of CCAMS was held May 3, 2005. At this meeting, the Federal Coordinator spoke on the role of CCAMS membership, the relationship of CCAMS to the National Science and Technology Council (NSTC) Committee on Environment and Natural Resources (CENR), how NSTC/CENR links to the CCSP, the relationship between the OFCM and the NSTC/CENR and CCSP, and products and organizations. Another important activity which is carried out in connection with the Federal Coordinator's role as member of the NSTC/CENR is review and concurrence of a number of CENR reports and materials. These include the *Terms of Reference for the Interagency Working Group on Earth Observations* (which has now been formally established as the Group on Earth Observations); a proposal for a new CENR Subcommittee on Science and Technology for Sustainability; CENR *Grand Challenges Report*; appendices, clearance memorandum, concurrence sheet, draft, and final *Strategic Plan for the U.S. Integrated Earth Observation System*; the document *Science and Technology Lessons Learned from the December 26, 2004 Indian Ocean Disaster*; and the plan *Tsunami Risk Reduction for the United States: A Framework for Action*.

Another accomplishment concerns an OFCM request of the CCAMS agencies to complete a survey to identify new climate products that have

been developed and implemented since the Board on Atmospheric Sciences and Climate defined "climate services" in 2001 as "the timely production and delivery of useful climate data, information, and knowledge to decision makers." On September 21, 2005, the results of the survey were forwarded to the Director of the U.S. Climate Change Science Program. The Federal Coordinator noted that the climate services activities should be considered an integral part of the CCSP. Further, the OFCM is using its infrastructure to reach out and invite many government, private, and academic individuals to attend the November 14-16, 2005, *Climate Science in Support of Decision Making* workshop; and the OFCM has agreed to provide financial support for an evening poster session of the workshop.

OPERATIONAL PROCESSING

The OFCM Committee for Operational Processing Centers (COPC) addresses processing and backup capabilities of NOAA's National Centers for Environmental Prediction and Office of Satellite Data Processing and Distribution, the Air Force Weather Agency, and the U.S. Navy's Fleet Numerical Meteorology and Oceanography Center and Naval Oceanographic Office. During FY 2005, the COPC continued to make progress in areas such as model development, observing strategies, database architecture, and backup requirements. The COPC has begun activities in the area of High Performance Computing and Communications (HPCC). An HPCC model run was conducted on the Weather Research and Forecasting (WRF) Operational Test Bed Distributed Center computers to demonstrate the capability of grid computing and to establish the feasibility of a DOD Joint Operational Test Bed for the WRF modeling framework. In addition, efforts are underway to continue to improve backup support and capabili-

ties and to coordinate preparation for the implementation of the WRF system, in accordance with the *National Concept of Operations Framework for the Operational Processing Centers*, which is contained in an April 1, 2004, memorandum of agreement signed by the directors of the Operational Processing Centers. At the March 23-24, 2005, meeting of the COPC, the members endorsed the establishment of a new OFCM-sponsored National Operational Processing Centers (NOPC) Program Council for higher level organizational approval and monetary commitment. The COPC will report to the new program council, with the Working Group for Cooperative Support and Backup (WG/CSAB) reporting to the COPC. Three joint action groups (JAG) will report to WG/CSAB; these are the JAG for Operational Community Modeling (JAG/OCM), the JAG for Centralized Communications Management (JAG/CCM), and the JAG for Operational Data Acquisition for Assimilation (JAG/ODAA). Future COPC activities include JAG/OCM reporting on its progress in preparing a *WRF Joint Implementation Plan* and discussion of the charter for NOPC. The COPC will also consider a request from the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Senior Users Advisory Group (SUAG) for the OFCM COPC to provide oversight and foster the synergistic coordination, program development, and implementation of NPOESS data exploitation strategies.

ENVIRONMENTAL SUPPORT TO HOMELAND SECURITY

ATMOSPHERIC TRANSPORT AND DIFFUSION RESEARCH AND DEVELOPMENT PLAN

In September 2004, the OFCM completed work with applicable agencies in developing the report, *Federal Research Needs and Priorities for Atmospheric Transport and Diffusion*

Modeling, a FCMSSR action. The report is the result of a process that included consultation with subject-matter experts, including first responders and emergency managers; a careful analysis of research needs and current capabilities to respond to domestic incidents of national significance; a capability gap analysis; and the development of strategies to close the gaps. The report was briefed to the ICMSSR and FCMSSR at their November 16, 2004, and December 1, 2004, meetings, and both committees endorsed the report's recommendations. As a result, all agencies with a vested interest in atmospheric transport and diffusion modeling are to incorporate applicable recommendations into their planning, programming, and budgeting process. This plan is available for downloading from the Department of Homeland Security (DHS) Lessons Learned Information Sharing Web site, as is the August 2002 OFCM report *Atmospheric Modeling of Releases from Weapons of Mass Destruction-Response by Federal Agencies in Support of Homeland Security*. On July 19, 2005, the OFCM conducted a special session in conjunction with the 9th Annual George Mason University (GMU) Conference on *Atmospheric Transport and Dispersion Modeling* to begin to address, with the broader private and academic communities, the issue of uncertainty in ATD models—a capstone goal of the *Federal Research Needs and Priorities for Atmospheric Transport and Diffusion Modeling* report. In addition, the OFCM developed an ATD implementation strategy for the report's recommendations for which the OFCM has primary responsibility. The strategy was sent to the FCMSSR and ICMSSR members in August 2005 for their review and comments. The implementation strategy has three parts: (1) working with the agencies to identify and improve a baseline set of national ATD modeling capabilities; (2) helping the agencies

implement a common framework for model development and evaluation; and (3) recommending criteria for multifunctional joint urban test beds. Currently, the OFCM is moving forward to establish JAGs to address parts 2 and 3 of the strategy. Further, the implementation of the strategy and the work of the JAGs will fall under the purview of the Working Group for Urban Meteorology (WG/UM). As a result of the September 2004 Urban Meteorology Forum, the OFCM will focus future ATD modeling coordination efforts on urban areas and shift responsibility for these efforts from the Working Group for Environmental Support to Homeland Security to the WG/UM.

GEORGE MASON UNIVERSITY ATMOSPHERIC TRANSPORT AND DISPERSION MODELING CONFERENCE

George Mason University (GMU), Fairfax, Virginia, conducted its 9th Annual Conference on *Atmospheric Transport and Dispersion Modeling*, July 18-20, 2005. The OFCM partnered with GMU to sponsor the event. Technical topics of interest for the conference were: new developments in basic theories of boundary layer models and transport and dispersion models; urban-scale meteorological and dispersion experiments and models; computational fluid dynamics (CFD) model theory and applications; field experiments and laboratory experiments concerned with boundary layer studies and turbulence and dispersion studies; mesoscale meteorological modeling for input to transport and dispersion models; the use of remote sensing technology in boundary layer and transport and dispersion studies; model evaluation methods, uncertainty/sensitivity analyses, and risk assessments; improvements in model inputs (e.g., land-use data, 3-D building data) and output visualizations; and methods and criteria for emergency response and decision-making.

On July 19, 2005, the OFCM hosted a session related to the OFCM's ongoing work with the Department of Homeland Security and other members of the Federal meteorological community. The main focus of the ongoing work was to define the concept of operations and the research and development needs required to support the National Incident Management System and emergency responders at Federal, state, and local levels. The OFCM session topic was *Uncertainty in Atmospheric Transport and Diffusion (ATD) Models*. The Federal Coordinator noted that the session objectives were to facilitate a discussion of uncertainties in ATD modeling systems that incorporates academic and private sector inputs, and accounts for uncertainty in meteorological observations and models and in dispersion models; and to help Federal agencies striving to improve their ATD modeling systems to implement the recommendations made by the OFCM JAG for Atmospheric Transport and Diffusion (Research and Development Plan) in their publication *Federal Research and Development Needs and Priorities for Atmospheric Transport and Diffusion Modeling (2004)*. He also stated that the way ahead included: complete the strategy for ATD modeling improvements and present it to the FCMSSR (key elements of the strategy are a core set of ATD modeling systems, recovery of existing ATD data, common framework for model evaluation, and ATD test beds); and through partnership and collaboration within the Federal meteorological community and its customers, the OFCM will continue to identify shortfalls in urban meteorology, and help to organize improvements across all applicable focus areas that will better support users in the urban environment. On August 26, 2005, the OFCM *Implementation Strategy for Federal Atmospheric Transport and Diffusion Modeling and Measurement Improvements* was for-

warded to the FCMSSR members.

HOMELAND SECURITY ENVIRONMENTAL SUPPORT PLAN

The *Homeland Security Environmental Support Plan*, an action from the FCMSSR, will define the mission, roles, and responsibilities of individual Federal agencies as they relate to homeland security and will document each agency's environmental support capabilities and/or requirements. The OFCM worked closely with the Plume Modeling Subset of the Consequence Management, Site Restoration/Cleanup (CMS) Subgroup, which is chaired by the Department of Homeland Security (Emergency Preparedness and Response), to develop an interagency concept of operations for an all-hazards dispersion support framework. The concept of the Interagency Modeling and Atmospheric Assessment Center (IMAAC) was successfully proposed to the Homeland Security Council Deputies and adopted in April 2004. The IMAAC began operations in an interim capacity in April 2004. The seven departments and agencies participating in the IMAAC-DOC/NOAA, DOD, DOE, DHS/S&T, EPA, NASA, and NRC-developed an interagency Memorandum of Understanding (MOU). In the MOU, each agency agreed to participate in the Senior Management Council (SMC) and Senior Scientific Advisory Council (SSAC) and to develop an annex detailing agency-specific roles and responsibilities and implementation details. When fully implemented, the IMAAC will support the development and implementation of a set of IMAAC products, capitalizing on the Federal agencies' suite of meteorological and ATD models that DHS can use to respond to incidents of national significance. While the initial goal was to complete the *Homeland Security Environmental Support Plan* by the end of FY 2005, successful completion rests with the completion of the IMAAC

concept of operations, which, at this point, is still evolving.

ANNUAL FEDERAL PLAN

In October 2004, the OFCM issued *The Federal Plan for Meteorological Services and Supporting Research-Fiscal Year 2005*. The Federal Plan is congressionally mandated and is a one-of-a-kind document which articulates the meteorological services provided and supporting research conducted by agencies of the Federal government. The Federal Plan helps to reduce overlap and duplication among the agencies. It is a comprehensive publication that documents proposed programs for Fiscal Year (FY) 2005 and reviews agency programs in FY 2004. The plan demonstrates to the Congress and to the Executive Branch how the Federal agencies work together to accomplish their missions in an effective and efficient manner. The special interest article in the FY 2005 Annual Federal Plan, *The Rewards of Managing Weather-Related Risks*, focused on the Federal agencies' meteorological activities related to risk management and assessments, and the socioeconomic impacts of natural hazards. During January 2005, the OFCM issued a call for agency input to *The Federal Plan for Meteorological Services and Supporting Research-Fiscal Year 2006*. The feature article for the FY 2006 Annual Federal Plan focuses on the Federal agencies' meteorological activities related to minimizing the impact of wildland fires on the urban environment; its title is *Living with Wildland Fire in the Urban Environment*.

WEATHER INFORMATION FOR SURFACE TRANSPORTATION

The ICMSSR received an update on weather information for surface transportation (WIST) at its November 16, 2004, meeting. The ICMSSR supported the Working Group for Weather Information for Surface Transportation (WG/WIST) actions to allow all Fed-

eral departments and agencies to participate in the development of plans or projects to meet their WIST needs and ensure Federal resources are used efficiently; to develop a multiyear, Federal WIST research program plan to bring together the Federal weather and surface transportation research communities and provide a vision for the public and private sectors to use for planning purposes; and to develop an overarching, multiagency-coordinated WIST implementation program. WG/WIST is actively working on its tasks with interagency meetings on January 27, March 16, April 28, July 11, and September 15, 2005, and making additional progress between meetings. The OFCM's *Weather Information for Surface Transportation-National Needs Assessment Report* (December 2002) is a groundbreaking requirements report which has provided the foundation for both NOAA and DOT surface weather program initiatives. It was also fully endorsed by the FCMSSR, the DOT Under Secretary for Policy, and VADM Conrad C. Lautenbacher, Jr., USN (Ret.), Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, and Ms. Mary E. Peters, FHWA Administrator during their August 18, 2003, meeting. The work of the WG/WIST, jointly chaired by NOAA and FHWA, was again later endorsed in the July 20, 2005, Memorandum of Understanding signed by VADM Conrad C. Lautenbacher, Jr., USN (Ret.) and Ms. Mary E. Peters. Timely and accurate surface transportation information will support improvements in safety and efficiency in transportation operations.

Most recently, on September 23, 2005, OFCM forwarded to ICMSSR members the *Weather Information for Surface Transportation (WIST) Initiative Document-First Steps to Improve the Nation's WIST Capabilities and Services* (September 2005). This Initiative Document represents the initial recommendations of the WG/WIST

members on key actions and priorities that should be taken by the responsible agencies in the OFCM Federal coordinating infrastructure to collaborate on and address national surface transportation safety, mobility, and productivity issues. These proposed actions are focused on tackling the weather condition having the most impact on the surface transportation systems-liquid precipitation-and on other areas where ongoing R&D or other activities can be leveraged to improve weather information for surface transportation capabilities and services. While completing these initiatives is only the first step, this step is significant in that it will demonstrate the benefits gained when the responsible Federal agencies can develop a shared vision, together with the needed resources, to begin to address national surface transportation safety and efficiency issues. This document will be followed at a later date by both a WIST research and development plan and a WIST implementation plan, which will be developed by the OFCM-sponsored WG/WIST. The roadway portion of this activity is in accordance with Section 5308 (Road Weather Research and Development Program) of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)*, which was enacted August 10, 2005, and will support agency initiatives in road weather and education and training of road weather information users.

AVIATION WEATHER

In December 2004, the OFCM issued *Aviation Weather Programs/Projects-2004 Update* which updates the compilation of activities across Federal agencies that began with the *National Aviation Weather Initiatives Final Baseline Tier 3/4 Report*, distributed in 2001, and serves as a baseline report for the recently established Joint Planning and Development Office (JPDO) within

the Federal Aviation Administration (FAA). This document identifies all or most of the federally supported research and development (R&D) efforts relevant to reducing weather-related risks to aviation. Many of these activities include industry, university, and association partners. With this update, we have increased the focus on another objective of our compilation effort: tracking progress toward completing the R&D phase and transferring the results-whether as specific technology products or as improved information products and services-into aviation operations. This report also updates and extends the analysis of trends in weather-related aviation accidents that first appeared in the *National Aviation Weather Program Mid-Course Assessment*, published in August 2003, and endorsed by the FCMSSR, FAA, and the National Center for Atmospheric Research (NCAR). The effort to deliver improved weather risk reduction products and services must be supported and sustained. Particularly essential is education and training for all general aviation pilots on how to deal with the deadliest weather-related hazards. Weather hazards will always be with those who fly; our goal must be to continually reduce the risks from encountering these hazards. Additional accomplishments which are underway in the area of aviation weather support include follow-up activities from the June 21-24, 2004, *2nd International Conference on Volcanic Ash and Aviation Safety*. These include the development and coordination of interagency volcanic ash operations and implementation plans. The operations plan will identify procedures and agency responsibilities and contacts for responding to a volcanic ash release. The implementation plan will provide the roadmap for further improved science, new technologies for observing volcanic ash (e.g., NASA's efforts), improved detection (USGS), NOAA modeling

and forecasting (NAAC forecasts for aircraft avoidance), and education of the international community. The OFCM attended the National Business Aviation Association, Inc., and Friends and Partners in Aviation Weather Annual Meeting held in Las Vegas, Nevada, in October 2004, and will continue to implement the *National Aviation Weather Program* during FY 2005. The Federal interagency *Aviation Weather Program* has resulted in a major reduction of weather-related accidents. The program is on track for meeting the established goal to reduce weather-related accidents by 80 percent by 2007.

SPACE WEATHER

The overarching goal of the *National Space Weather Program* (NSWP), which is administered by an OFCM program council, is to achieve an active, synergistic, interagency system; providing timely, accurate, and reliable space weather warnings, observations, specifications, and forecasts by 2007. The *NSWP Strategic and Implementation Plans* provide, respectively, broad guidance and a detailed roadmap for the NSWP. It was noted at the November 16, 2004, and December 1, 2004, ICMSSR and FCMSSR meetings, respectively, that the program is nearing the end of the 10-year period, which was addressed in the strategic and implementation plans, and that it was time to perform an interagency assessment to look at the progress toward meeting its goals. It was determined that a comprehensive review of the NSWP was warranted to quantify the progress toward meeting the goals in observations, research, modeling, transition of research to operations, and education and outreach; to determine if actions detailed in the *NSWP Implementation Plan* are on target and moving in the direction detailed by the strategic plan; and to determine whether the strategic goals should be adjusted at this time based on emerg-

ing and evolving requirements. A National Space Weather Program Assessment Study Group has been formed and the strategy for completing the assessment completed. The review methodology was developed by the Committee for Space Weather (CSW) at its January 26, 2005, meeting, including who will do the assessment and how it will be completed. The NSWP Assessment Study Group met for the first time July 7-8, 2005. On September 27, 2005, an Interim Assessment Letter Report was sent to the Federal Coordinator and forwarded to FCMSSR members. The report contained early findings and areas where further investigation will take place. The outcome is important to NOAA and supports the item, "Develop and evaluate space environment forecast models," which is included in Table 13 (Research Milestones for Improving Weather Forecasts and Warnings) of NOAA's 5-year research plan (January 2005). The OFCM also participated in *Space Weather Week* from April 5-8, 2005, in Broomfield, Colorado. *Space Weather Week* was sponsored by NOAA Space Environment Center and partners, and is for users and researchers interested in space weather.

LIGHTNING DATA

The OFCM JAG for Lightning Detection Systems (JAG/LDS) met during FY 2004 to work on the new Lightning Data Contract. In addition, JAG/LDS members served as members of the Technical Evaluation and Business Committees for contract selection. The NOAA National Weather Service (NWS) contract was in effect beginning FY 2005. The new contract is for one base year and four one-year options. Some benefits are: (1) improving warning services by identifying and categorizing severe weather, (2) monitoring interagency resources needed for fire protection and services (e.g. resource allocations

for USDA Forest Service and DOI/BLM, and use of NOAA NWS Incident Meteorologists, especially in the Western and Alaska Regions), and (3) enabling improved transportation services by supporting a more efficient use of the National Airspace System, resulting in both cost savings to industry and the public as well as enhanced public safety. This activity supports NOAA's Strategic Plan Mission Goals to *Serve Society's Needs for Weather and Water Information* and *Support the Nation's Commerce with Information for Safe, Efficient, and Environmentally Sound Transportation*. JAG/LDS successfully completed its charge by its parent Committee for Environmental Services, Operations and Research Needs (CESORN), and the JAG was disestablished June 15, 2005, at the conclusion of its last meeting. Further actions regarding lightning detection systems will be addressed by CESORN.

PHASED ARRAY RADAR

The Phased Array Radar Project (PARP) was briefed to ICMSSR at its November 16, 2004, meeting. The ICMSSR supported the JAG's continued work to identify and document the potential needs and benefits that the phased array radar and an adaptive radar sensing strategy would address, and to integrate those identified needs into a multiagency-coordinated research and development (R&D) plan that would focus R&D efforts on meeting each agency's needs. JAG/PARP held its first meeting on December 7, 2004, and has continued to aggressively move forward to develop a comprehensive plan to document the operational, research, and technical weather radar needs of the Federal agencies. Working meetings were held May 12-13, June 22-23, and July 27, 2005. The plan will also prioritize the most pressing R&D needs and provide a roadmap to address those needs within the OFCM coordinating infra-

structure. A summary report was distributed to ICMSSR members in early October 2005; and the final multiagency-coordinated R&D plan will be completed by January 2006. This activity is supportive of the item, "Continue investigating the utility of phased array radar technologies," which is included in Table 13 (*Research Milestones for Improving Weather Forecasts and Warnings*) of NOAA's 5-year research plan (January 2005).

ATMOSPHERIC RESEARCH AND DATA ASSIMILATION/DATA MANAGEMENT

Atmospheric research and data assimilation/data management were challenges and issues discussed at the November 16, 2004, and the December 1, 2004, meetings of ICMSSR and FCMSSR, respectively. It was noted that there was a need to tie future research efforts in science, technology, and transition mechanisms to operational and societal requirements. Key areas such as urban meteorology, homeland security, mesoscale/microscale processes, aviation weather, weather information for surface transportation, and tropical cyclones were highlighted as needing attention. It was agreed that agencies will support research and development needs and requirements based on agency priorities and will continue to identify issues and concerns that are necessary for the development of capabilities required to realize societal benefits. Agencies will also support and facilitate opportunities for the transition of research into operational applications. Further comments and suggestions will be provided by the agencies to the Federal Coordinator to assist OFCM in the planning and development of a vision and implementation roadmap for the supporting research enterprise of the Federal meteorological community for the next decade.

Also highlighted at the ICMSSR and FCMSSR meetings were data assimilation and data management challenges the community faces, as the size of future data sets increase by orders of magnitude. Advanced modeling and data assimilation techniques are critical to improve the quality of analyses and model results and to maximize the value of the Global Earth Observation System of Systems (GEOSS). Agencies were very supportive of the need for further interagency collaboration efforts in this area. An action item stemming from the FCMSSR meeting was that Federal requirements and capabilities in key areas, like data management and data assimilation, need to be surveyed and further addressed. This interagency work fully supports NOAA's crosscutting priorities. It also supports the item, "Advance data assimilation techniques; satellite, radar, ocean, hydrologic, and land surface assimilation," which is included in Table 13 (*Research Milestones for Improving Weather Forecasts and Warnings*) of NOAA's 5-year research plan (January 2005).

In response to the above FCMSSR action item, the OFCM undertook a survey of Federal requirements and capabilities in the area of meteorological data assimilation and related data management. This effort comprised two component tasks: (1) identification of current operational requirements for data assimilation (e.g., uses of data assimilation in operational prediction and analysis) and of the ongoing and planned R&D, conducted or supported by Federal entities, for new or improved data assimilation capability; and (2) review of relevant crosscutting goals and objectives for atmospheric and meteorological services and supporting research and development (R&D), as a basis for future capability requirements for data assimilation.

On September 15, 2005, the OFCM provided to FCMSSR and ICMSSR members an interim survey/assessment

progress report on its efforts; the final report which will examine the gaps in our current data assimilation/data management capability, articulate the challenges that lie ahead in meeting future requirements, and propose a strategy to address these gaps in capability and future challenges, will be completed during January 2006.

COLLABORATION WITH NAS/NRC BOARD ON ATMOSPHERIC SCIENCES AND CLIMATE

The OFCM continued its mutually beneficial interactions with the National Academy of Sciences/National Research Council (NAS/NRC). The NAS/NRC Board on Atmospheric Sciences and Climate (BASC) conducted a planning meeting on June 21, 2005, to discuss *Mesoscale Observation Networks for Meeting Multiple National Needs*. In this planning meeting in which the Federal Coordinator for Meteorology was a participant, a small group of people were asked to brainstorm about a general issue that has been identified as a potential study topic. The Federal Coordinator helped BASC to better define the issue and identify whether an Academy study on the topic would be valuable. The Federal Coordinator noted that the multitude of meteorological impacts on the urban environment alone would warrant the proposed BASC study, and that all five primary focus areas within urban meteorology (severe weather, homeland security, air quality, water quality, and climate) discussed during the *Forum on Urban Meteorology-Meeting Weather Needs in the Urban Community*, conducted by OFCM, September 21-23, 2004, would benefit from improved mesoscale and urban scale observational capabilities. The Federal Coordinator provided a detailed listing of possible study tasks and, also, identified potential sources of observational needs and current capabilities informa-

tion.

COLLABORATION WITH THE COMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES

CENR PRINCIPALS

The Federal Coordinator continues to be a participant on the Committee on Environment and Natural Resources (CENR), and continues to assist CENR through review and concurrence of CENR reports and materials. These include the *Terms of Reference for the Interagency Working Group on Earth Observations* (which has now been formally established as the Group on Earth Observations); a proposal for a new CENR Subcommittee on Science and Technology for Sustainability; CENR *Grand Challenges Report*; appendices, clearance memorandum, concurrence sheet, draft, and final *Strategic Plan for the U.S. Integrated Earth Observation System*; the document *Science and Technology Lessons Learned from the December 26, 2004 Indian Ocean Disaster*; and the plan *Tsunami Risk Reduction for the United States: A Framework for Action*.

SUBCOMMITTEE ON DISASTER REDUCTION

The OFCM has been an active participant in the work of the CENR Subcommittee on Disaster Reduction (SDR). Recognizing that disasters can be the result of a technological and/or natural hazard, the subcommittee changed its name from the Subcommittee on Natural Disaster Reduction to the Subcommittee on Disaster Reduction (SDR). Recently, the focus of this group has been to enhance disaster resilience by composing a 10-year agenda for science and technology activities that will produce a dramatic reduction in the loss of life and property from natural and technological disasters. This 10-year agenda

identifies a suite of Grand Challenges for disaster reduction. It cuts across all hazards and disaster management stages and identifies priorities for research and investment. Addressing these Grand Challenges will improve the Nation's capacity to prevent and recover from disasters. OFCM is committed to working with SDR to provide a forum for information sharing, development of collaborative opportunities, and interactive dialogue with the U.S. policy community to advance informed strategies for managing risks associated with natural and technological disasters. The Grand Challenges document will contribute to U.S. government planning activities on a number of levels, especially in the area of enhancing the Nation's safety and economic well-being.

Immediately following the Indian Ocean tsunami, Dr. Kathie Olsen (Associate Director for Science, Office of Science and Technology Policy, Executive Office of the President) asked the SDR to identify the science and technology lessons learned from the disaster. The OFCM representation on the SDR helped the SDR identify a number of areas for focused Federal attention. Some of the areas identified included (1) targeted risk assessment of at-risk communities, (2) the need for clear warnings reaching everyone at risk, and (3) the need to address both national and regional challenges to reduce the threat of tsunamis and other coastal hazards. As part of the CENR tsunami documents clearance process, the Federal Coordinator emphasized a critical area which required additional emphasis in the document *Science and Technology Lessons Learned from the December 26, 2004 Indian Ocean Disaster* and the plan *Tsunami Risk Reduction for the United States: A Framework for Action*—that is, whether planning for a tsunami, a hurricane, or other hazards, response plans need to account for the entire demographics of the at-risk population—especially the

poor, seniors, the disabled, and individuals in poor health—ensuring the at-risk population has a mechanism to obtain safe haven.

In addition, through the OFCM representation on the SDR, the OFCM has helped craft the subcommittee's annual operations plan.

AMERICAN METEOROLOGICAL SOCIETY

During FY 2005, the OFCM joined leading environmental science and service corporations in supporting undergraduate scholarships in the atmospheric and related oceanic and hydrologic sciences. The scholarships, awarded for the junior and senior years, are designed to encourage outstanding undergraduates to pursue careers in the fields covered by the awards. The OFCM plans to continue this support. The OFCM also supports American Meteorological Society (AMS) endeavors by participating in AMS conferences and workshops and other environmental science education and outreach programs. The OFCM staff cochaired the *21st AMS Conference on Weather Analysis and Forecasting* held in Washington, D.C., August 1-5, 2005. The focus for this conference was *Educating and Training the User Community and the Public on Weather Analysis and Forecasting*. In addition, the Federal Coordinator participated in three important AMS-sponsored activities including: the *AMS Corporate Forum* on March 31, 2005, in the Washington, D.C. area, at which he gave a cross-agency and international perspective on GOES-R rebroadcast; *The Future of the U.S. Weather Prediction Enterprise*, July 26-28, 2005, in Boulder, Colorado; and the *Golden Jubilee Symposium*, September 20-21, 2005, in Research Triangle Park, North Carolina, where he served as the session chair for the role of air quality models in decision making.

INTERNATIONAL SUPPORT

The Federal Coordinator provided a comprehensive briefing on the OFCM and interagency coordination of Federal meteorological activities to Dr. Xu Xiaofeng and a delegation of 25 individuals from the Chinese Meteorological Administration, on May 24, 2005. Then on August 24, 2005, the Federal Coordinator hosted and briefed Dr. Zheng Guoguang, Deputy Administrator of the Chinese Meteorological Administration. Also, news media from Japan attended and conducted interviews at the 59th Interdepartmental Hurricane Conference in Jacksonville, Florida, March 7-11, 2005.

PUBLICATIONS AND OFCM'S WEB SITE.

The following publications were prepared in hardcopy form and/or have been placed on OFCM's Web site (www.ofcm.gov):

- *The Federal Plan for Meteorological Services and Supporting Research—Fiscal Year 2005*
- *Federal Atmospheric Transport and Diffusion Research and Development Plan*
- *Aviation Weather Programs/Projects-2004 Update (Tier ¾ Baseline Update)*
- *Proceedings of the 2nd International Conference on Volcanic Ash and Aviation Safety*
- *Proceedings of the User Forum on Urban Meteorology*
- *National Hurricane Operations Plan*
- *Federal Meteorological Handbook No. 1—Surface Weather Observations and Reports*

The following documents are

planned for publication during FY 2006:

- *The Federal Plan for Meteorological Services and Supporting Research-Fiscal Year 2006*

- *National Hurricane Operations Plan*

- *Homeland Security Environmental Support Plan*

- *Federal Meteorological Handbook No. 3-Rawinsonde and Pibal Observations*

- *Federal Meteorological Handbook No. 11-Doppler Radar Meteorological Observations; Part B-Doppler Radar Theory and Meteorology*

- *Federal Meteorological Handbook No. 11-Doppler Radar Meteorological Observations; Part C-WSR-88D Products and Algorithms*

- *Federal Meteorological Handbook No. 11-Doppler Radar Meteorological Observations; Part D-WSR-88D Unit Description and Operational Analysis*

- *Federal Meteorological Handbook No. 12-United States Meteorological Codes and Coding Practices*

During FY 2005, OFCM continued to make substantial progress on its use of the Internet. In addition to information about the office, OFCM has placed its current publications on its Web site, and keeps the Web site current with information regarding workshops and forums being conducted by the office. OFCM will continue to make information available on the Internet during FY 2006.

Table A.1 Current OFCM Publications

<u>Publication Title</u>	<u>Date</u>	<u>Number</u>
<i>Federal Plan for Meteorological Services and Supporting Research, Fiscal Year 2005</i>	October 2004	FCM-P1-2004
<i>Urban Meteorology: Meeting Weather Needs in the Urban Community</i>	January 2004	FCM-R22-2004
National Plan for Space Environment Services and Supporting Research: 1993-1997	August 1993	FCM-P10-1993
<i>National Severe Local Storms Operations Plan</i>	May 2001	FCM-P11-2001
<i>National Hurricane Operations Plan</i> <i>WSR-88D Tropical Cyclone Operations Plan</i>	May 2005	FCM-P12-2005
<i>National Winter Storms Operations Plan</i>	December 2003	FCM-P13-2003
Federal Plan for Cooperative Support and Backup Among Operational Processing Centers	Nov 2002	FCM-P14-2002
National Plan for Stratospheric Monitoring, 1988-1997	July 1989	FCM-P17-1989
National Aircraft Icing Technology Plan	April 1986	FCM-P20-1986
National Plan to Improve Aircraft Icing Forecasts	July 1986	FCM-P21-1986
Federal Plan for the Coordination of Automated Weather Information System Programs	May 1988	FCM-P23-1988
Federal Plan for Meteorological Information Management	July 1991	FCM-P24-1991
<i>National Plan for Tropical Cyclone Research and Reconnaissance (1997-2002)</i>	January 1997	FCM-P25-1997
National Aviation Weather Program Plan	September 1992	FCM-P27-1992
National Geostationary Operational Environmental Satellite (GOES) Data Collection System (DCS) Operations Plan	August 1997	FCM-P28-1997
Federal Plan for Marine Environmental Data, Services, and Supporting Research	June 1996	FCM-P29-1996
<i>The National Space Weather Program: Strategic Plan</i>	August 1995	FCM-P30-1995
<i>The National Space Weather Program: Implementation Plan - 2nd Edition</i>	July 2000	FCM-P31-2000
<i>National Aviation Weather Strategic Plan</i>	April 1997	FCM-P32-1997
<i>National Post-Storm Data Acquisition Plan</i>	March 2003	FCM-P33-2003
<i>National Aviation Weather Initiatives</i>	February 1999	FCM-P34-1999
National Aviation Weather Initiatives, Final Baseline Tier 3 and 4 Report	April 2001	Unnumbered
<i>National Aviation Weather Program/Projects (Tier 3/4 Baseline Update)</i>	December 2003	FCM-R21-2003
<i>Federal Meteorological Handbook No. 1 - Surface Weather Observations and Reports</i>	September 2005	FCM-H1-2005

Table A.1 Current OFCM Publications (cont.)

<u>Publication Title</u>	<u>Date</u>	<u>Number</u>
Federal Meteorological Handbook No. 2 - Surface Synoptic Codes	December 1988	FCM-H2-1988
Surface Synoptic Code Tables (Update)	July 1990	FCM-T1-1990
<i>Federal Meteorological Handbook No. 3 - Rawinsonde and Pibal Observations</i>	May 1997	FCM-H3-1997
Federal Meteorological Handbook No. 10 - Meteorological Rocket Observations	December 1988	FCM-H10-1988
Federal Meteorological Handbook No. 11 - Doppler Radar Meteorological Observations		
Part A - System Concepts, Responsibilities and Procedures	June 2003	FCM-H11A-2003
Part B - Doppler Radar Theory and Meteorology	June 1990	FCM-H11B-1990
Part C - WSR-88D Products and Algorithms	February 1991	FCM-H11C-1991
Part D - WSR-88D Unit Description and Operational Analysis	April 1992	FCM-H11D-1992
<i>Federal Meteorological Handbook No. 12 - United States Meteorological Codes and Coding Practices</i>	December 1998	FCM-H12-1998
<i>Directory of Atmospheric Transport and Diffusion Consequence Assessment Models</i>	March 1999	FCM-I3-1999
<i>Federal Directory of Mobile Meteorological Equipment and Capabilities</i>	December 1995	FCM-I5-1995
<i>A Guide to WMO Code Form FM 94 BUFR</i>	March 1995	FCM-I6-1995
Tropical Cyclone Studies	December 1988	FCM-R11-1988
Tropical Cyclone Studies Supplement	August 1989	FCM-R11-1988S
<i>Interdepartmental Meteorological Data Exchange System Report, IMDES</i>	August 1998	FCM-R12-1998
Federal Meteorological Requirements 2000	October 1990	FCM-R13-1990
<i>U.S. Wind Profiler: A Review</i>	March 1998	FCM-R14-1998
Atmospheric Modeling of Releases from Weapons of Mass Destruction	August 2002	FCM-R17-2002
<i>Weather Information for Surface Transportation--National Needs Assessment Report</i>	December 2002	FCM-R18-2002
<i>Report on Wind Chill Temperature and Extreme Heat Indices: Evaluation and Improvement Projects</i>	January 2003	FCM-R19-2003
<i>National Aviation Weather Program Mid-Course Assessment</i>	August 2003	FCN-R20-2003
Standard Formats for Weather Data Exchange Among Automated Weather Information Systems	November 1994	FCM-S2-1994
Standard Telecommunication Procedures for Weather Data Exchange (under revision)	October 1991	FCM-S3-1991
<i>Federal Standard for Siting Meteorological Sensors at Airports</i>	August 1994	FCM-S4-1994
<i>Proceedings of the Workshop on Multiscale Atmospheric Dispersion Modeling within the Federal Community</i>	June 2000	
<i>Proceedings of the Aviation Weather User Forum--Aviation Weather: Opportunities for Implementation</i>	July 2000	

Table A.1 Current OFCM Publications (cont.)

<u>Publication Title</u>	<u>Date</u>	<u>Number</u>
<i>Proceedings for the Symposium on Weather Information for Surface Transportation: Delivering Improved Safety and Efficiency for Tomorrow</i>	<i>February 2000</i>	
<i>Proceedings of the Symposium on Weather Information for Surface Transportation -- Preparing for the Future: Improved Weather Information for Decision Makers</i>	<i>March 2001</i>	
<i>Proceedings of the Forum on Risk Management and Assessment of Natural Hazards</i>	<i>July 2001</i>	
<i>Proceedings of the Workshop on Strategy for Providing Atmospheric Information</i>	<i>March 2002</i>	
<i>Aviation Weather Training: A Report on Training for Emerging and Recently Implemented Aviation Weather Programs</i>	<i>April 2002</i>	<i>FCM-R16-2002</i>
<i>Proceedings of the Workshop on Effective Emergency Response</i>	<i>May 2002</i>	
<i>Federal Research and Development Needs and Priorities for Atmospheric Transport and Diffusion Modeling</i>	<i>September 2004</i>	<i>FCM-R23-2004</i>
<i>Aviation Weather Programs/Projects-2004 Update (Tier ¾ Baseline Update)</i>	<i>December 2004</i>	<i>FCM-R21-2004</i>
<i>Proceedings of the 2nd International Conference on Volcanic Ash and Aviation Safety</i>	<i>November 2004</i>	
<i>Proceedings of the User Forum on Urban Meteorology</i>	<i>March 2005</i>	

Italics = publication available online at www.ofcm.gov"